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PRELIMINARY ENGINEERING REPORT MODIFICATION OF THE GODDARD OPTICAL RESEARCH FACILITY

AUGUST 1967

NASA

GODDARD SPACE FLIGHT CENTER

GREENBELT, MARYLAND

PRELIMINARY ENGINEERING REPORT

MODIFICATION OF THE GODDARD OPTICAL RESEARCH FACILITY

AT

GODDARD SPACE FLIGHT CENTER

GREENBELT MARYLAND

PREPARED BY:

Facilities Engineering Division
National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland

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SECTION I - PROJECT REQUIREMENT

A. Addition to Existing Building, Coelostat & Precise Control System

The Goddard Optical Research Facility is employed in a program at GSFC to apply modern optical techniques to the expanding requirements of the Space Program. These include precise tracking and position determination of satellites with lasers, in which GSFC has achieved precision orders of magnitude beyond any other tracking method. The technique is being adopted by U. S. military agencies and other countries, even while R&D continues at GSFC to further advance the method. The technique was first demonstrated at Goddard Optical Research Facility. In the future, we will extend it to velocity tracking as well as range, we will incorporate means for optical tracking day and night, and improve the precision. These functions are vital to geodesy, orbit determination of scientific satellites, rocket guidance, etc.

In addition GORF supports research in optical communication. Ultimately this may be the prime communication link to deep space. Goddard Optical Research Facility (GORF) will be used to perform research, test developments, and ultimately to participate in operations and experiments with satellites and planetary probes.

The facility is unique. No large optical instruments now can point with accuracy needed by lasers, have a coelostat, and do R&D like ours.

If no extension is made to GORF, the program will be stifled. Newly developed lasers cannot be used until the coelostat is available. GORF is now so crowded, we cannot fully exploit the results of OART program (natural consequence of entire Optical Technology investment).

The facility is required in addition to a Southwest Optical Research Facility or OTTOS. The local facility is used for preliminary testing close to the laboratory and enables us to return to the laboratory for improvements, study practical problems and verify principles of system operation. Only when technology is sufficiently advanced, when the local facility begins to limit operation because

a) Instrument is too small
b) Washington, D. C. environment is not good enough
c) Laser safety to local aircraft must be considered

are we justified in the expense and trouble of moving to a mountain site out west. So far, we have, and will continue for a long time to find these limitations permit us to do a great deal of valuable work close by. As portions of the program develop, they should be moved to a better western site, but GORF will always be more and more valuable in performing tests on the frontiers of the field.

B. Field Elevated Laboratory

The Optical Systems Branch is presently engaged in a program to determine the effects of atmospheric turbulence upon coherent laser communication. This program is essential to the orderly development of the laser as a means of tracking and communication. Present efforts employ a 0.8 kilometer laser range located at the Goddard Optical Research Facility. At this range, measurements of the refractive index structure constant (C_N^2) are being made and correlated to coherent reception signal to noise ratios. Based upon these experiments, and upon the basic atmospheric theory of Totarski, as well as recent experiments by Fried, an orderly means of propagation analysis will be developed to allow the systematic design of laser communication systems.

The present range is inadequate because the path of propagation is too close to the ground turbulence layer, and because the range available is too short. In order to adequately simulate the ground to spacecraft turbulence condition, a range must be established which has most of the propagation path at least 100 feet above the surrounding terrain. Further, the range must for logistical reasons be in close proximity to GSFC.

As a result of an investigation of possible ranges, a range from the GSFC water tower to the Goddard Optical Research Facility appears most practical. The water tower appears well suited as one end of the laser link becuase it is the highest point in the vicinity of GSFC, and because due to its large mass, it is relatively stable and free of vibration. Since logistical support at GSFC and GORF are already in existence, the logistical problems are minimized.

If the elevated laboratory is not constructed, the atmospheric turbulence program objectives will be defeated by the lack of a range simulating earth to space turbulence conditions. This may result in many costly design mistakes being made in future coherent laser communication systems.

Data which will be obtained with this laboratory are refractive index structure constants as a function of wave length, coherence apertures as a function of wave length temperature gradient profile and their relationship to the refractive index structure constant, coherent reception signal to noise ratios as a function of collector aperture and refractive index structure constant, and active trading coherent reception signal to noise ratio as a function of collector aperture.

SECTION II - PROJECT DISCRIPTION

The Goddard Optical Research Facility presently consists of: a small building with a roll-back roof, which houses the Multi-Mode telescope, the Realtime Automatic Digital Optical Tracker (RADOT), a precise Timing System, electronic control equipment and desks for operational personnel; two temporary wooden shelters, which house experimental Laser Ranging Tracking Mounts; two surplus trailers, which house the electronics for the ranging system; and an Astrodome with a 20-inch equatorial mount. In addition, occasional optical equipment is temporarily placed outdoors at the facility for experiments and checkout. This facility has been developed to support the OART programs under the cognizance of the Optical Systems Branch. Under the following OART tasks equipment and subsystems are being field evaluated at the site and experimental data is being obtained to support and guide optical tracking and communication development:

Doppler Receiver for Argon Laser Tracking
CO_2 Stabilized Laser
CW Argon Laser Doppler Transmitter
Coherent Optical Receiver Studies
Optical Instrumentation Development
Pulsed Laser Ranging Research
10.6 Micron Satellite Experiments

In the five years, approximately, during which GORF has been occupied, the optical program has grown in scope, complexity, and volume. In addition to the OART tasks performed at GORF, which resulted in such successful developments as precision laser satellite tracking and automatic tracking telescopes, a large number of projects have been supported by the facility. These include Beacon-Explorer, GEOS, UK, Echo, PAGEOS, lunar studies, and tracking network support. The equipment built into the facility, which must be used on a permanent basis has now become greater than can be accommodated in the existing structures, the advances in laser technology dictate new instruments and new experiments. We shall discuss each of the four CofF items in greater detail.

A. Addition to Existing Building

All present work areas are overcrowded. The instrument observing area, which is 32' x 25' is completely utilized by the Multi-Mode Telescope, RADOT, and Multi-Mode Control Console. The basement of this building loses a large portion of its area to the concrete support piers for the two telescopes which extend many feet into the ground. In addition, there are seven racks of electronic equipment for the digital servo control system for the Multi-Mode Telescope, and three racks for the Timing Standard System, a control console

A. Addition to Existing Building (Cont'd.)

and data handling system for the RADOT, and desks or work benches for approximately nine operating personnel. The proposed expansion of the building will provide an additional 2,500 square feet of working area. (See drawings.) A basement will be put under the instrument preparation laboratory and new office area. The new observing area will have four isolated and stabilized piers, one for the coelostat, to be described later, and three for experiment components such as lasers and detectors working in conjunction with the coelostat. The observatory area will also have a roll-back roof.

B. Coelostat

The field experiments and laser operations at GORF have shown an urgent need for a large optical instrument in which the focal point or image plane remains fixed in space while its beam direction tracks over the entire sky. Mechanical deflection problems are being encountered when the laser is carried on the tracking mount, as we have been forced to do, thus requiring it to operate in all attitudes. A coelostat brings the received or transmitted light through the rotating axes by means of a series of mirrors, so that the final ray is stationary. Such an instrument is needed to support the many field experiments being conducted at GORF and planned for the future. The coelostat will permit project engineers to set up on the isolated piers at least three independent experiments completely without interfering or tying up an entire tracking system. By rotating an azimuth mirror any one of the experiments may be chosen to operate through the instrument. Large, heavy lasers and detectors can be mounted in a horizontal position on stabilized piers, divorcing the lasers from mount vibrations and avoiding deflection problems. Heavy power cables and cooling hoses will not have to be handled with cable-wraps to avoid affecting the servo system. Further laser development will be greatly enhanced by relaxing these mechanical requirements and we can expect to eliminate the long instrument setup time required on a conventioal telescope. It is proposed to develop a 36-inch optical coelostat in the form of an Azimuth-Elevation type of tracking mount with a Coude focus. The optics will be designed for the visible as well as for IR wavelengths.

C. Precise Control System

The experience gained in the development of precise control systems for RADOT, Multi-Mode Mount, GEOS, and Laser Ranging Systems have shown the advantage of in-line computer techniques. The control system to be developed for the coelostat will consist of a general purpose computer that will be capable of controlling several instrumentation

C. Precise Control System (Cont'd.)

systems simultaneously. This development not only provides the control and data-handling system for the coelostat but it will serve as a prototype development for future Optical Technology Test and Operations Station Control Systems.

D. Field Elevated Laboratory

The elevated field laboratory will be constructed on top of an existing water tower at the GSFC which was originally designed and constructed with structural members to support such a facility. The facility will provide approximately 1200 square feet of laboratory space to house electronic and optical systems necessary to conduct horizontal experiments in propagation of coherent light through the atmosphere, with GORF as the second terminal.

SECTION III - PROJECT ANALYSIS & BASIC DESIGN CRITERIA

A. Site

1. Addition to Existing Building

a. Site Selection

The function of the proposed facility dictates its close proximity to the existing GORF facilities. This will result in a multi-use of personnel and of the facilities both existing and proposed. The site chosen is the existing optical research facility site located approximately two miles northeast of Goddard Space Flight Center, Greenbelt, Maryland.

b. Service

The existing access road to the west side of the building will be relocated to allow for the addition. This access road will be used for bulk deliveries to the basement level.

c. Roads and Parking Area

(1) As indicated above, the access road to the west side of the basement will be relocated to make room for the addition.

(2) A 25-car parking lot will be added near the entrance to the site to service the new facility personnel and to alleviate the existing shortage of parking facilities on the site.

(3) All new roads and parking areas shall have a compacted basecourse and a minimum of a single bituminous surface treatment designed for a 20 ton capacity.

2. Field Elevated Laboratory

a. Site Selection

The site chosen for the elevated laboratory is on top of the existing water tower at GSFC. The tower has been designed and built with the future capability of supporting a laboratory. The technical justification for having the laboratory elevated has been explained in Section I - Project Requirements.

b. Service and Roads

No additional roads will be needed. A pedestrian walk leading from the Building 16 parking lot to the base of the proposed elevator will be installed.

B. Architectural

1. Addition to Existing Building

a. Module

The addition shall be designed and constructed using masonry units layed out on a modular basis consistent with architectural and structural systems and materials.

b. Aesthetics

The choice of the building materials and facade appearance will be similar to the existing structures for purposes of (1) correlating the old and the new, (2) function of design elements and (3) economy in construction.

c. General

The choice of the systems for the facility is governed by the function, i.e., the coelostat must not be subject to ground vibration; therefore, a special isolation footing must be designed for it to be mounted on.

d. Typical features to be incorporated include:

(1) Load bearing exterior walls (concrete masonry units)

(2) Raised floor in the computer area for cables

(3) Resilient flooring in all areas except observatory

(4) Lay in ceiling in office, corridor and toilet areas (ceiling of toilet room shall be material not susceptible to moisture or odor retention)

(5) Ceramic tile wainscot and floor in toilet room

(6) Sliding roof over observatory area to be constructed of lightweight metal, to be well insulated, to be electrically operated and have a maximum opening time of four minutes

(7) All basement walls that will be below grade to be water proofed to prevent dampness in computer area.

2. Field Elevated Laboratory

a. Module

There is an existing platform frame on the water tower that was designed to support a laboratory. Its shape is hexagonal and measures 20' 0" across the flats. This frame will be incorporated in the design of the proposed laboratory. The use of the existing frame will lower the construction costs.

b. Aesthetics

The laboratory will be located 130 feet above the ground. Because of its highly visible position every effort will be made to make the laboratory aesthetically pleasing within the constraints of the budget.

c. General

The choice of systems will be governed by (1) the existing hexagonal frame, (2) the laboratory's prominent position (it should express the nature of Goddard's activities), (3) the function of the laboratory (i.e., perimeter windows that can be opened to allow laser beams to be sent and received from any direction; this capability will be needed in future experiments).

d. Typical Features

(1) A 1200 pound capacity electric elevator, 130 foot travel, two stops, at 100 feet per minute will be installed to transport personnel to the laboratory.

(2) Perimeter casement windows to allow for maximum laser experiment flexibility.

(3) Floor structure to have capability of supporting two 2-ton tables used for laser mounts.

(4) Curtain wall construction will be used because of its light weight, its ability to receive large glass areas, and aesthetic versatility. An air plenum will be incorporated along the bottom of the curtain wall to handle cool air distribution.

C. Civil - Structural

1. Addition to Existing Building

a. Foundation

In the area to be excavated a reinforced concrete wall will extend from the basement to the first floor level. In the unexcavated area a footing 2'-6 below grade is required to support the concrete block wall structure. Individual column footings are to be provided for the steel frame which supports the metal roof in its retracted position. All concrete will be 3000 PSI air-entrained. The allowable net bearing pressure of the soil is assumed to be 4000 PSF. Individual pier footings will support the steel frame track system.

b. Structure

This building will be a duplicate of the existing in that the walls will be concrete block and the roof over the new telescope will be pre-fab light-gage metal and retractable. A crane will be provided on a rolling A-frame. Removable panels in the roof section will allow the crane to be retracted when the roof is in place. Tracks for rolling components will be mounted on a structural steel frame. Insolated reinforced concrete piers are provided for the telescope and at three equi-distant points around a central pier.

2. Field Elevated Laboratory

a. Structural System

The structural system to support the floor is existing, however, loads not originally designed for are now proposed which necessitate modifications to the structure. These will include steel pipe columns gusseted to tower legs and a purlin to girder system utilizing steel beams. The floor will consist of lightweight concrete on metal ribbed deck. The roof and walls will be metal rib panels over steel framing.

b. Elevator

(1) Foundation - The foundation design will be based on individual column footings. Concrete piers will be approximately eight feet below grade.

(2) Structure - The elevator tower will be constructed of A36 steel thoughout, capable of supporting a 1200 pound L.L. plus the D.L. of the elevator and motor controls.

D. Plumbing

1. Addition to Existing Building

a. Water System

(1) The Observatory site will be served by cold water that is supplied from a deep water well with a submersible pump located on Goddard's adjoining Nursery site.

(2) Hot water will be supplied from the existing building's hot water system.

(3) The existing self contained water cooler will be reused in the new building configuration.

(4) Fire protection will be Government furnished fire extinguishers.

(5) Fixtures will be of vitreous china. Water closets will be wall hung siphon jet type hand operated flush tanks. Lavatories will be wall hung with splash lip and soap dispenser.

b. Sanitary System

(1) The toilet areas, floor drains and sink type waste will be drained into the Optical Observatory's existing septic drain system.

c. Storm System

(1) Roof and clear water drainage will be collected and discharged to the ground.

(2) Footing drains will be employed if required by soil conditions.

2. Field Elevated Laboratory

a. Extent of Work

(1) No plumbing work is required.

b. Fire Protection

(1) Fire protection will be Government furnished fire extinguishers.

E. Air Conditioning, Heating & Ventilating

1. Addition to the Existing Building

a. Air Conditioning

(1) Summer Conditions

Outside maximum design point	95 F DB	78 F WB
Inside maximum design point	75 F DB	50% RH

Winter Conditions

Outside minimum design point	10 F DB	
Inside minimum design point	70 F DB	30% RH

(2) Air conditioning will be provided in office areas, observatory and computer spaces.

(3) Office and observatory areas will be conditioned with packaged wall or window mounted direct expansion fan coil type units.

(4) A separate packaged air conditioning unit will serve the computer areas.

b. Heating

(1) All building rooms will be heated electrically with convectors or cabinet type fan unit heaters.

c. Ventilation

(1) Toilet areas will be exhausted at the rate of 20 air changes per hour. Make-up air for toilet exhaust system will be drawn from adjacent conditioned areas.

2. Field Elevated Laboratory

a. Air Conditioning

(1) Summer Conditions

Outside maximum design point	95 F DB	78 F WB
Inside maximum design point	75 F DB	50% RH

(2) Winter Conditions

Outside minimum design point	10 F DB	
Inside minimum design point	70 F DB	30% RH

(3) The building will be conditioned with packaged wall or window mounted direct expansion fan coil type units.

b. Heating

(1) The building will be heated electrically with convectors or cabinet type fan unit heaters.

F. Electrical

1. Addition to Existing Building

a. General

(1) The building will be supplied at 120/208 volt three phase four wire for lighting and utility loads.

(2) The building will be supplied at 480 volt three phase three wire for heating and cooling power.

(3) The new building system for lighting and utility power will be fed from the existing 400 ampere service panel in the existing observatory.

(4) The new building power will be furnished from a new 480 volt panel fed from an outdoor 480 volt load center.

(5) Emergency standby power will be furnished at 120/208 volts three phase four wire through an automatic transfer switching arrangement.

b. Estimated Electrical Loads

(1) 120/208 volt three phase four wire

(a) Lighting - 2500 square feet @ 10 watts/square foot-25KVA

(b) Utility Power

- Office area-400 square feet @ 5 watts/square foot - 2KVA

(b) Utility Power (Cont'd.)

- Observatory area-900 square feet @ 50 watts/ square foot - 45KVA

- Laboratory area - 1200 square feet @ 20 watts/ square foot - 24KVA

- Roof motor - two roofs @ 1HP - 2KVA

(2) 277/480 volt three phase three wire

(a) Water pump - 1KVA

(b) Heating - 30 KVA

(c) Air Conditioning - 15KVA

c. Power Distribution

(1) Primary power will be furnished from 13,800 volt three phase three wire service from Goddard Space Flight Center.

(2) Standby primary power will be furnished from existing 4160 volt three phase four wire system from Agricultural Research Center.

(3) Secondary power will be obtained from outdoor load center using 13,800-277/480 volt three phase three wire liquid filled transformer and 480-120/208 volt three phase four wire liquid filled transformer.

(4) Low voltage service will be supplied from new branch circuit panelboards located as required.

d. Lighting

(1) Lighting in office area will be surface mounted fluorescent fixtures similar to fixtures in existing building.

(2) Lighting in observatory area will be roof-mounted incandescent fixtures with supplemental lighting supplied by wall mounted incandescent fixtures.

(3) Lighting in the laboratory area will be ceiling mounted incandescent fixtures.

e. Utility Power

(1) Office area will be supplied with duplex receptacles mounted 18" above the finished floor on six foot centers around perimeter of room.

(2) Observatory area will be supplied with duplex receptacles mounted 4'6" above finished floor and spaced on four foot centers around the perimeter of the room.

(3) The laboratory area will be supplied with receptacles raceway mounted 4'0" above finished floor with double duplex receptacles mounted on two foot centers.

f. Grounding

(1) Individual ground wires will be run from distribution panels to receptacles and motors.

(2) An insulated ground system will be provided in the laboratory areas.

(3) A building ground loop will be provided around the building with connections to ground rods and the building electrical system.

2. Field Elevated Laboratory

a. General

(1) The building will be supplied with power using 120/208 volt three phase four wire service.

(2) Power will be supplied from an existing outdoor substation at the base of the tower.

b. Estimated Electrical Loads

(1) Lighting - 1,000 square feet @ 5 watts/square foot-5KW

(2) Utility Power - 1,000 square feet @ 20 watts/square foot-20 KW

(3) Heating and Cooling Power-3KW

(4) Elevator Power-10KW

c. Power Distribution

(1) Secondary power will be obtained from outdoor substation at 120/208V three phase four wire.

(2) Secondary power will be distributed in the room from branch circuit panelboards as required.

d. Lighting in the laboratory room will be surface mounted incandescent fixtures.

e. Utility power will be supplied by electrical raceway mounted below the window line and with double duplex receptacles spaced at three foot intervals around the perimeter of the room.

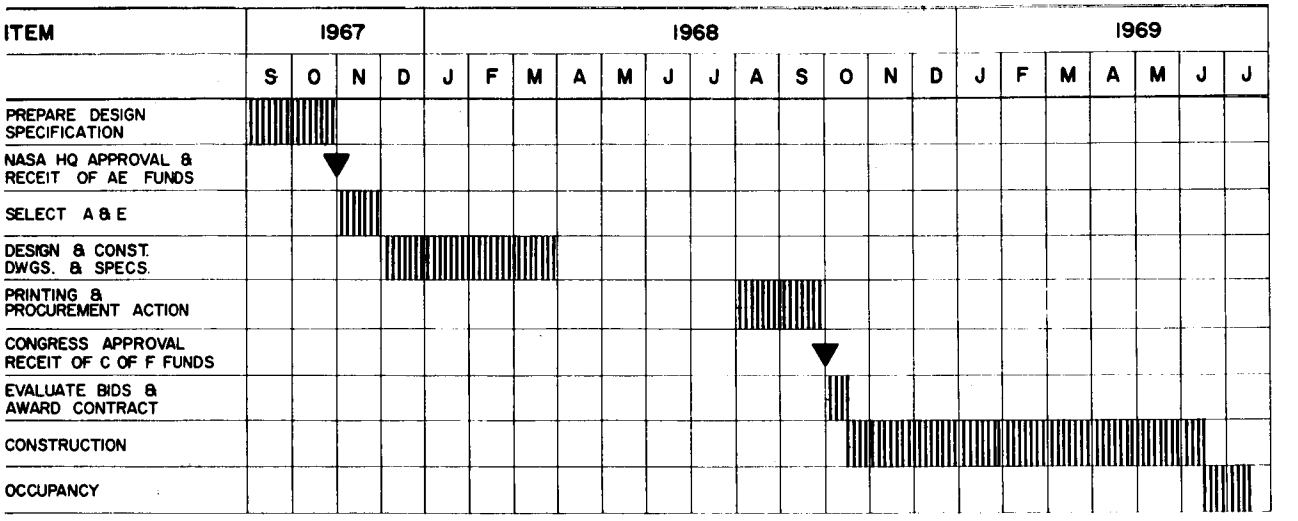
f. Grounding

(1) Individual ground wires will be run from the distribution panels to receptacles and motors.

(2) The building will be grounded to the tower steel.

(3) An insulated laboratory ground will be provided with connection terminals in the receptacle raceway connected by cable to a grounding counterpoise at the base of the tower.

SECTION IV SCHEDULE FOR CONSTRUCTION OF ADDITION TO EXIST. BLDG. & FIELD ELEVATED LABORATORY



SECTION V. P. E. R. ESTIMATE

LINE ITEM TITLE	EST. COST
1. ADDITION TO EXISTING BUILDING AND	148,978
2. FIELD ELEVATED LABORATORY	86,795
ESTIMATED ARCHITECT AND ENGINEER FEE	16,527
TOTAL	252,300

1. ADDITION TO EXISTING BUILDING

A. PRINCIPAL CONSTRUCTION FEATURES

DESCRIPTION	UNIT	QUANTITIES	ENGINEERING EST. UNIT COST	ENGINEERING EST. COST	BUDGET EST. UNIT COST	BUDGET EST. COST
GENERAL	S. F.	2500	19.50	48,750	21.45	53,625
ELECTRICAL	S. F.	2500	9.42	23,560	10.36	25,916
HEATING, VENT. AIR CONDITION.	S. F.	2500	5.25	13,125	5.77	14,437
PLUMBING	S. F.	2500	2.00	5,000	2.20	5,500
SUB TOTAL			36.17	90,435	39.78	99,478

B. SUPPORTING CONSTRUCTION FEATURES

SLIDING ROOF	L. S.	—	—	21,000	—	23,100
CRANE	L. S.	—	—	15,000	—	16,500
RELOCATED ROAD	L. S.	—	—	2,500	—	2,750
PARKING LOT	L. S.	—	—	6,500	—	7,150
SUB TOTAL			—	45,000	—	49,500
TOTAL (ADDITION TO EXISTING BUILDING)						148,978

2. FIELD ELEVATED LABORATORY

A. PRINCIPAL CONSTRUCTION FEATURES

GENERAL	S. F.	1200	25.00	30,000	27.50	33,000
ELECTRICAL	S. F	1200	3.35	4,030	3.70	4,433
HEATING, VENT. AIR CONDITION.	S. F	1200	4.06	4,875	'6	5,362
PLUMBING	S. F.	—	—	—0—	—	—0—
SUB TOTAL			32.41	38,905	35.66	42,795

B. SUPPORTING CONSTRUCTION FEATURES

ELEVATOR & ELEVATOR TOWER	L. S.	—	—	40,000	—	44,000
SUB TOTAL			—	40,000	—	44,000
TOTAL (FIELD ELEVATED LABORATORY)						86,795

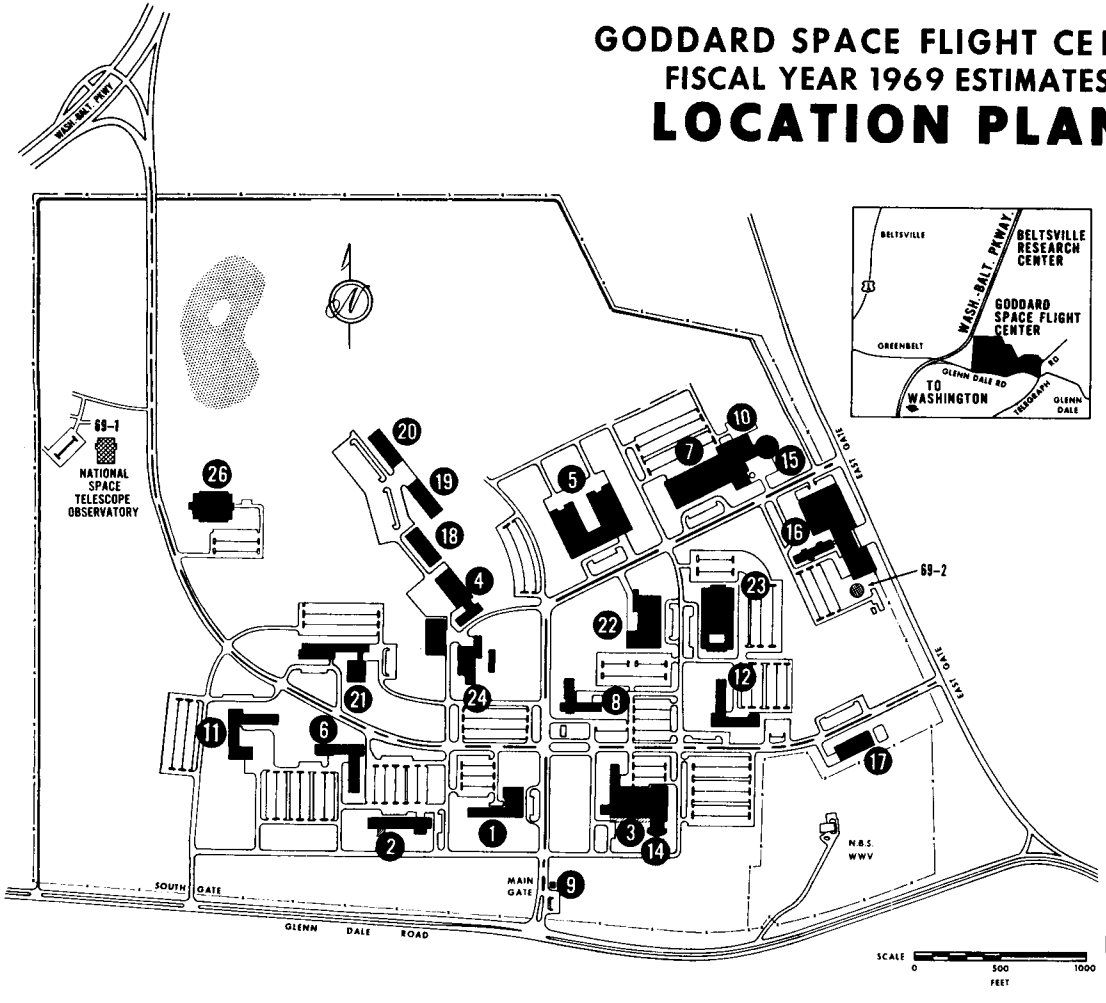
LINE ITEM TOTAL 235,773

C = CONTINGENCY = 10%
E = ENGINEERING ESTIMATE
BUDGET ESTIMATE = E(1.00 + .10) = 1.10 E

P.E.R. ESTIMATE

DISCRIPTION	UNIT	EST. COST
ADDITION TO EXISTING BLDG. &	ITEMIZED PREVIOUS PAGE	
FIELD ELEVATED LABORATORY		252,300
CEOLOSTAT	L. S.	285,000
CEOLOSTAT DESIGN FEE	L. S.	15,000
PRECISE CONTROL SYSTEM	L. S.	200,000
TOTAL		**752,300**

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1969 ESTIMATES
LOCATION PLAN



1. SPACE PROJECTS BUILDING
2. RESEARCH PROJECTS LABORATORY
3. CENTRAL FLIGHT CONTROL AND RANGE OPERATIONS LABORATORY
4. BOILER HOUSE AND ELECTRIC SUBSTATION
5. INSTRUMENT CONSTRUCTION AND INSTALLATION LABORATORY
6. SPACE SCIENCES LABORATORY
7. PAYLOAD TESTING FACILITY
8. SATELLITE SYSTEMS LABORATORY
9. GATE HOUSE
10. ENVIRONMENTAL TESTING LABORATORY
11. APPLIED SCIENCES LABORATORY
12. TRACKING AND TELEMETRY LABORATORY
14. SPACECRAFT OPERATIONS FACILITY
15. LAUNCH PHASE SIMULATOR
16. DEVELOPMENT OPERATIONS BUILDING
17. MULTI-PURPOSE BUILDING
18. MULTI-PURPOSE BUILDING
19. MULTI-PURPOSE BUILDING
20. MULTI-PURPOSE BUILDING
21. METEOROLOGICAL SYSTEMS DEVELOPMENT LABORATORY
22. MECHANICAL TEST FACILITY AND QUALITY ASSURANCE LABORATORY
23. DATA INTERPRETATION LABORATORY
24. ADDITION TO CENTRAL HEATING AND REFRIGERATION PLANT
26. NASA SPACE SCIENCE DATA CENTER

FACILITIES PROPOSED IN 1969 ESTIMATES

69-1 NATIONAL SPACE TELESCOPE OBSERVATORY

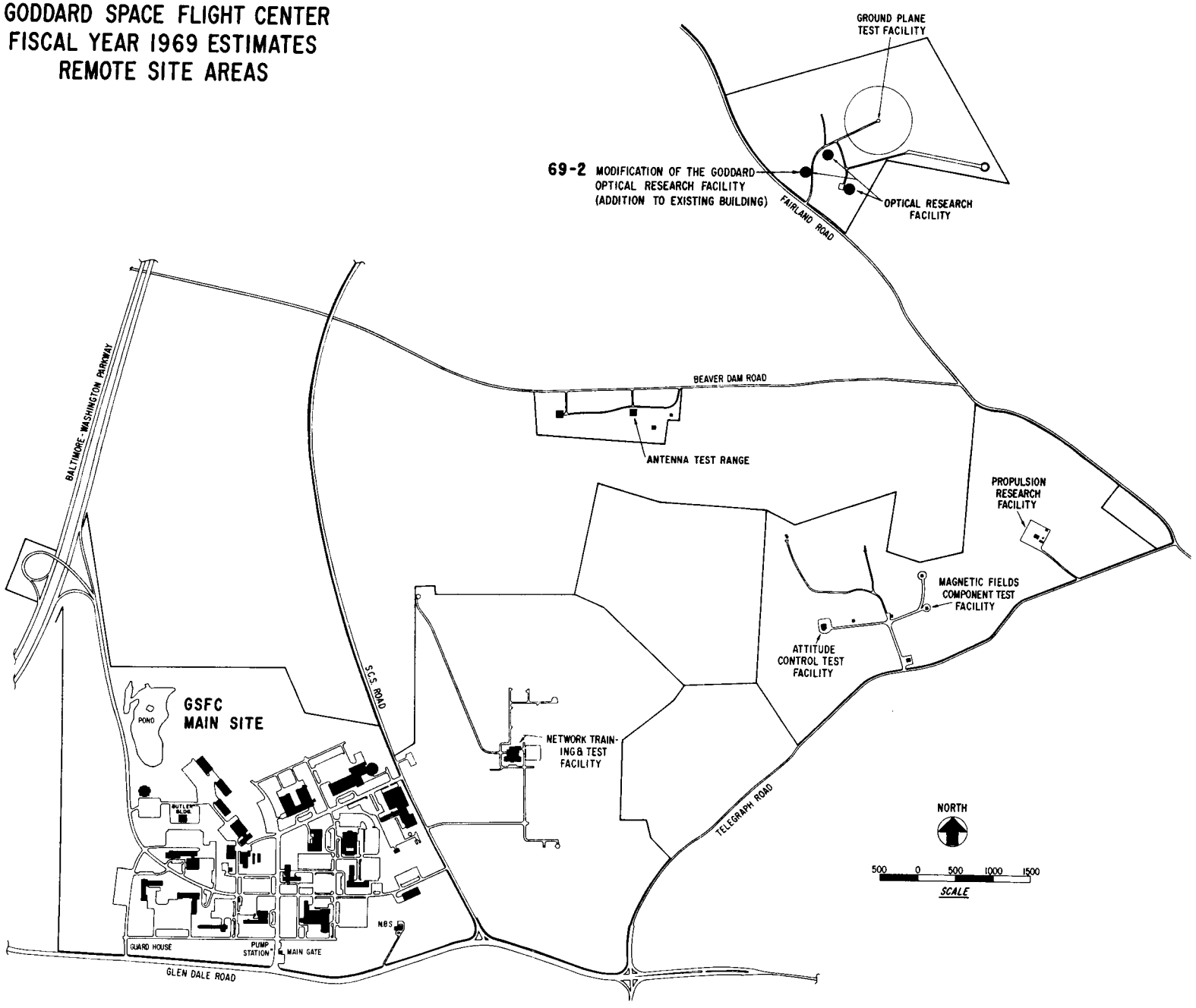
69-2 MODIFICATION OF THE GODDARD OPTICAL RESEARCH FACILITY (FIELD ELEVATED LABORATORY)

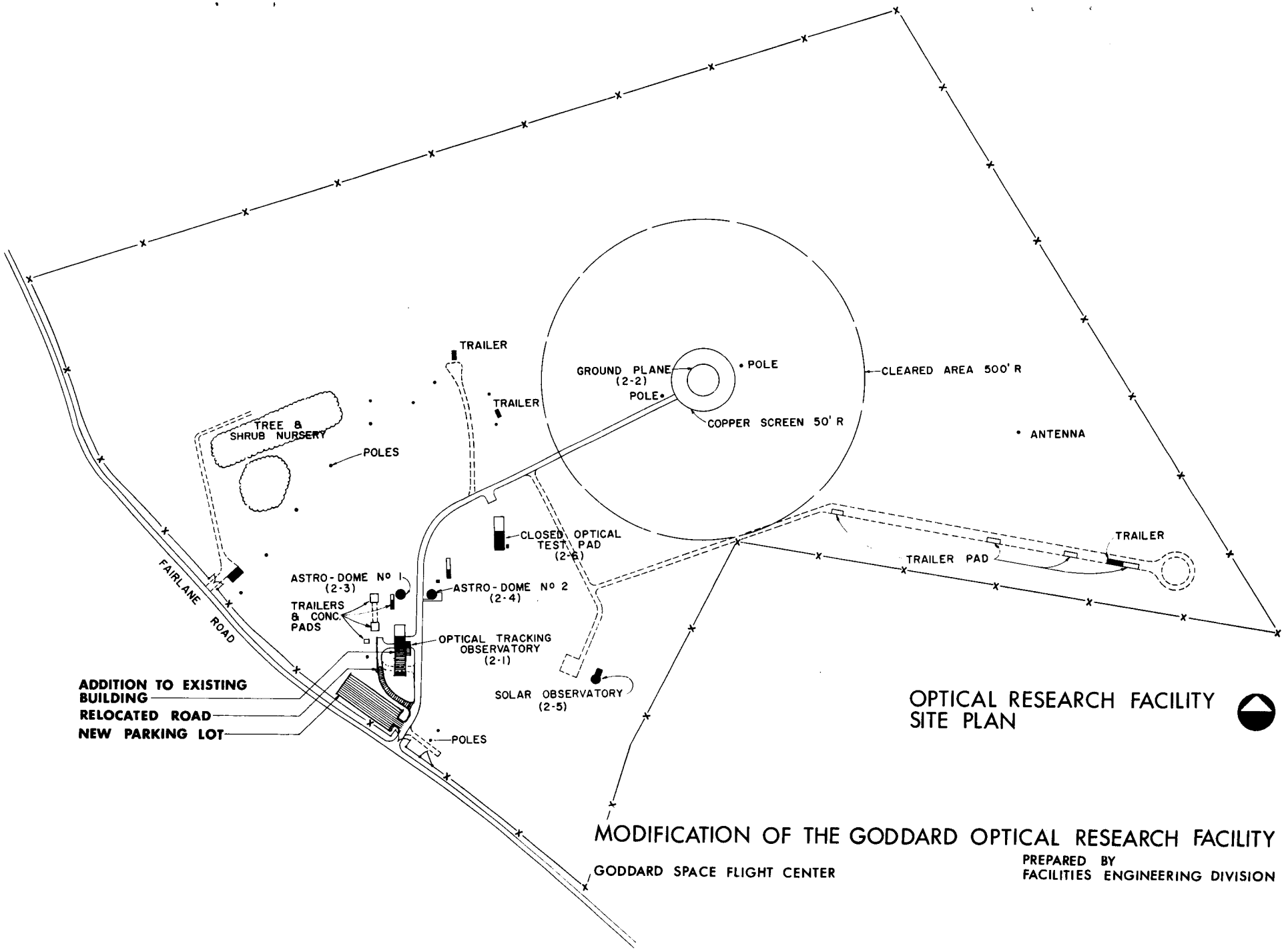
EXISTING FACILITIES

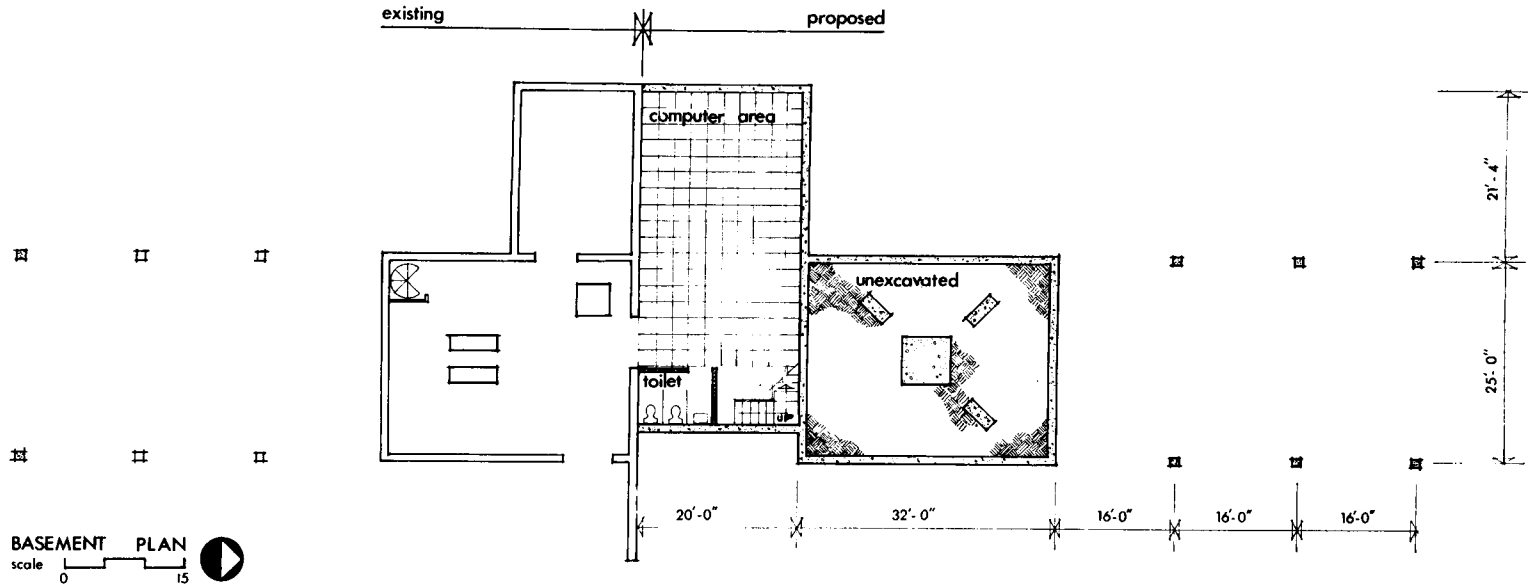
FACILITIES UNDER CONSTRUCTION

FACILITIES PROPOSED IN 1969 ESTIMATES

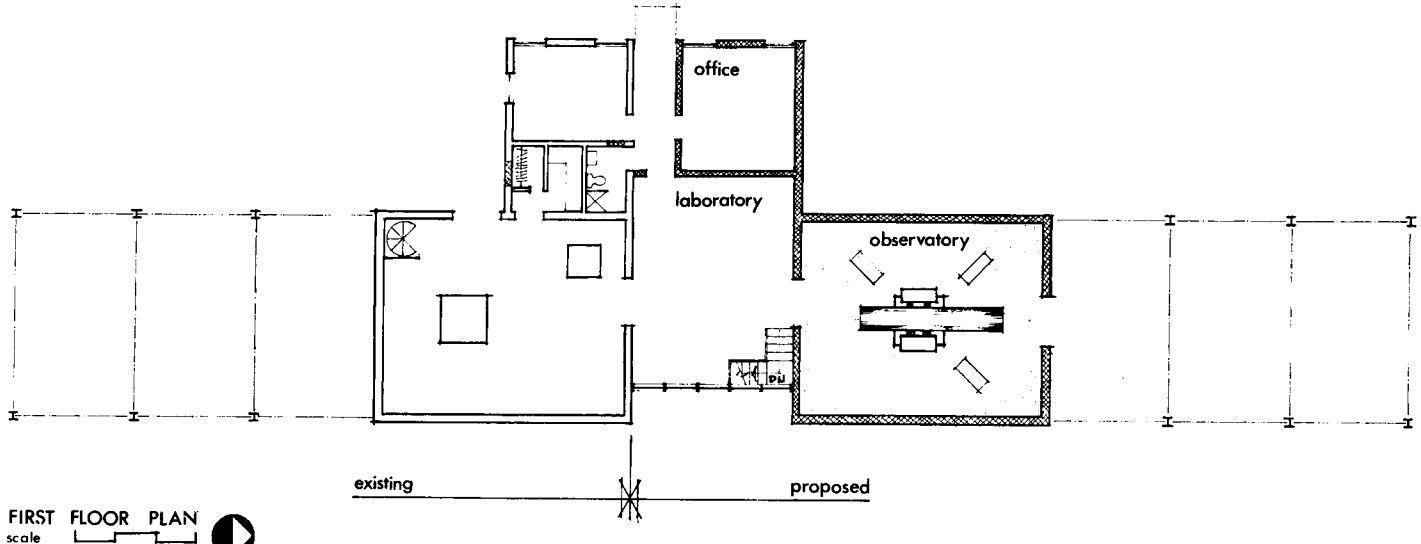
GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1969 ESTIMATES
REMOTE SITE AREAS




TRAILER
TRAILER
GROUND PLANE (2-2)
POLE
POLE
CLEARED AREA 500' R
COPPER SCREEN 50' R
ANTENNA
TREE & SHRUB NURSERY
POLES
CLOSED OPTICAL TEST PAD (2-6)
TRAILER
TRAILER PAD
FAIRLANE ROAD
ASTRO-DOME No 1 (2-3)
ASTRO-DOME No 2 (2-4)
TRAILERS & CONC. PADS
OPTICAL TRACKING OBSERVATORY (2-1)
SOLAR OBSERVATORY (2-5)
ADDITION TO EXISTING BUILDING
RELOCATED ROAD
NEW PARKING LOT
POLES
OPTICAL RESEARCH FACILITY SITE PLAN
MODIFICATION OF THE GODDARD OPTICAL RESEARCH FACILITY
GODDARD SPACE FLIGHT CENTER
PREPARED BY FACILITIES ENGINEERING DIVISION



BASEMENT PLAN
scale 0 15

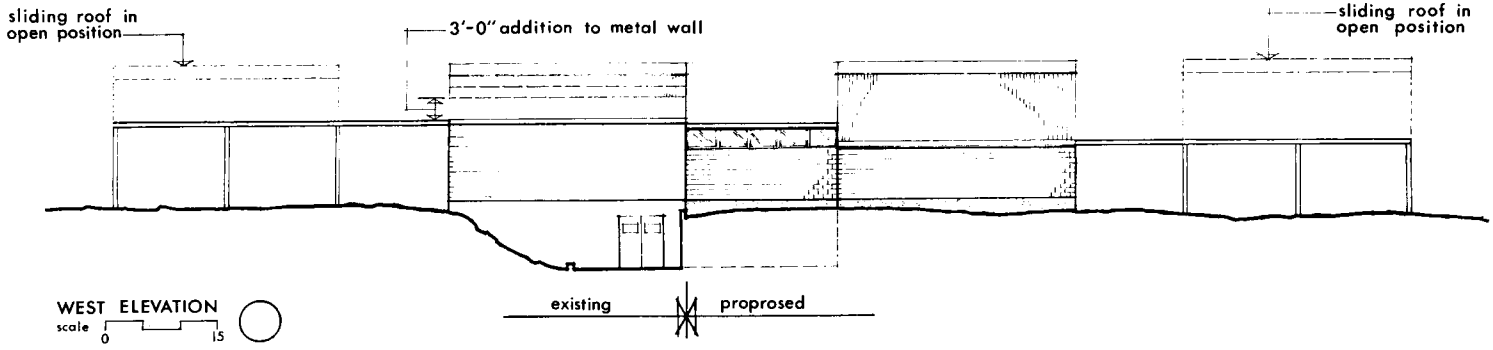


FIRST FLOOR PLAN
scale 0 15

MODIFICATION OF THE GODDARD OPTICAL RESEARCH FACILITY

ADDITION TO EXISTING BUILDING
GODDARD SPACE FLIGHT CENTER

PREPARED BY
FACILITIES ENGINEERING DIVISION



WEST ELEVATION
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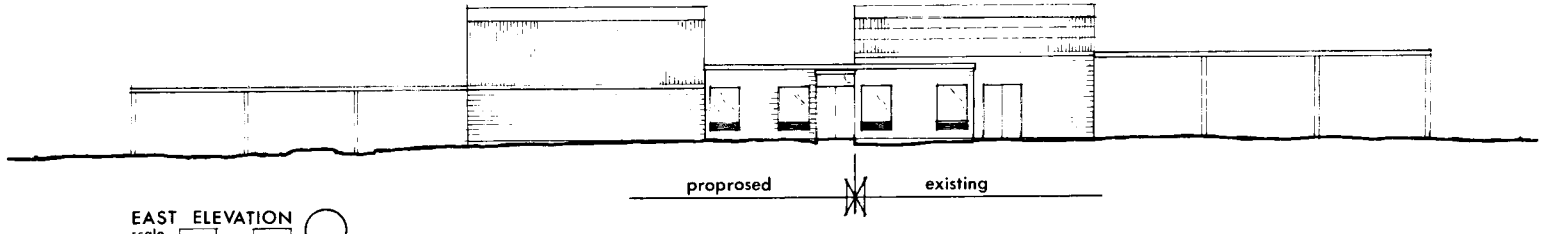

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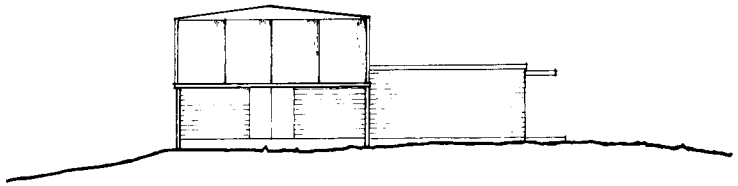

SOUTH ELEVATION
scale 0 15

MODIFICATION OF THE GODDARD OPTICAL RESEARCH FACILITY

ADDITION TO EXISTING BUILDING
GODDARD SPACE FLIGHT CENTER

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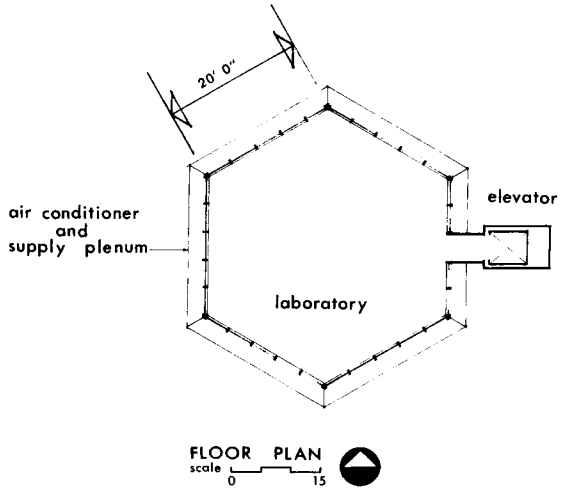

FLOOR PLAN
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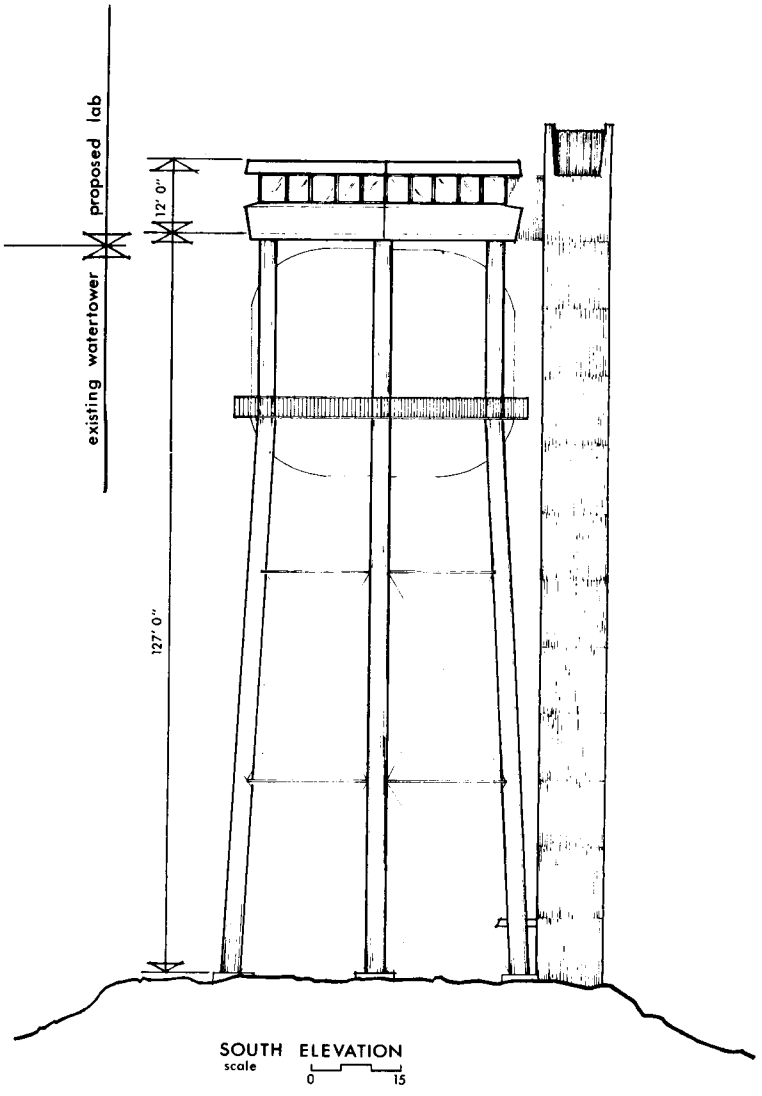

SOUTH ELEVATION
scale 0 15

MODIFICATION OF THE GODDARD OPTICAL RESEARCH FACILITY

FIELD ELEVATED LABORATORY
GODDARD SPACE FLIGHT CENTER

PREPARED BY
FACILITIES ENGINEERING DIVISION